

AMENDMENT

In the claims

Please cancel claims 1-20 and add new claims 21-54.

21. (new) A chemical sensing element for sensing a chemical, the chemical sensing element comprising:

 a microcantilever beam; and

 a dense reactive layer that specifically absorbs the chemical, wherein the reactive layer is deposited on the microcantilever beam and configured to resist relaxation and to expand as it absorbs the chemical, thereby causing the microcantilever beam to deflect and allowing the presence of the chemical to be sensed.

22. (new) A chemical sensing element according to claim 21 wherein the reactive layer is deposited and densified on the microcantilever beam through physical vapor deposition with concurrent ion bombardment.

23. (new) A chemical sensing element according to claim 22 wherein the concurrent ion bombardment is performed using a secondary ion source.

24. (new) A chemical sensing element according to claim 22 wherein the physical vapor deposition is a process selected from the group consisting of thermal evaporation, electron evaporation, and ion beam evaporation.

25. A chemical sensing element according to claim 21 wherein the reactive layer is deposited and densified on the microcantilever beam through sputter deposition with concurrent ion bombardment of the reactive layer.

26. (new) A chemical sensing element according to claim 25 wherein the sputter deposition process is selected from the group consisting of RF diode sputtering, magnetron sputtering with an applied substrate bias, and unbalanced magnetron sputtering.

27. (new) A chemical sensing element according to claim 21 wherein the dense reactive layer is applied on the microcantilever beam using physical vapor deposition with concurrent heating of the microcantilever beam.

28. (new) A chemical sensing element according to claim 21 wherein the dense reactive layer is applied on the microcantilever beam using sputter deposition with concurrent heating of the microcantilever beam.

29. (new) A chemical sensing element according to claim 21 wherein the reactive layer comprises palladium, a palladium alloy, platinum, or a platinum alloy.

30. (new) A chemical sensing element according to claim 21 wherein the reactive layer comprises a palladium alloy.

32. (new) A chemical sensing element according to claim 30 wherein the palladium alloy is a palladium-nickel alloy.

33. (new) A chemical sensing element according to claim 32 wherein the palladium-nickel alloy comprises more than about 87% palladium and less than about 13% nickel.

34. (new) A chemical sensing element according to claim 32 wherein the palladium-nickel alloy comprises about 90% palladium and about 10% nickel.

35. (new) A chemical sensing element according to claim 21 wherein the reactive layer has a thickness of between about 10 nm and about 100 nm.

36. (new) A chemical sensing element according to claim 21 wherein the reactive layer has a thickness of about 20 nm.

37. (new) A chemical sensing element according to claim 21 that further comprises an adhesion layer layered on the microcantilever beam prior to deposition of the reactive layer.

38. (new) A chemical sensing element according to claim 37 wherein the adhesion layer comprises titanium or zirconium.

39. (new) A chemical sensing element according to claim 37 wherein the adhesion layer comprises zirconium and has a thickness of about 5 nm.

40. (new) A chemical sensing element according to claim 21 wherein the chemical to be sensed is hydrogen.

41. (new) A chemical sensor comprising:

a. a chemical sensing element for sensing a chemical, the chemical sensing element comprising:

a microcantilever beam; and

a dense reactive layer that specifically absorbs the chemical, wherein the reactive layer is deposited on the microcantilever beam and configured to resist relaxation and to expand as it absorbs the chemical, thereby causing the microcantilever beam to deflect and allowing the presence of the chemical to be sensed;

b. a stationary baseplate positioned adjacent to the microcantilever beam such that a condition that exists between the microcantilever beam and the baseplate can change when the reactive layer absorbs the chemical and causes the microcantilever beam to deflect; and

c. a sensing circuit for measuring a change caused by deflection of the microcantilever beam in response to the reactive layer absorbing the chemical, wherein a change in capacitance is indicative of an amount of the chemical in a gas exposed to the sensor.

42. (new) A chemical sensor according to claim 41 wherein the sensing circuit comprises a sensing circuit selected from the group consisting of a capacitance sensing circuit for measuring a change in capacitance caused by deflection of the microcantilever beam, a piezoresistance sensing circuit for measuring a piezoresistive change caused by deflection of the microcantilever beam, and an optical lever for measuring deflection of the microcantilever beam.

43. (new) A chemical sensor according to claim 41 further comprising a processor for determining the amount of the chemical based on the amount of deflection of the microcantilever beam.

44. (new) A chemical sensor according to claim 43 further comprising a temperature sensor for measuring temperature interference, and wherein the processor is configured to correct the determined amount of the chemical based on the measured temperature interference.

45. (new) A chemical sensor according to claim 43 further comprising a humidity sensor for measuring humidity interference, and wherein the processor configured to correct the determined amount of the chemical based on the measured humidity interference.

46. (new) A chemical sensor according to claim 41 further comprising a reference sensor for providing a baseline reference, wherein the reference sensor comprises a microcantilever beam without a reactive layer.

47. (new) A chemical sensor according to claim 41 further comprising a transmitter for transmitting data comprising the amount of the chemical to a receiver positioned at a location remote from the sensor.

48. (new) A chemical sensor according to claim 47 wherein the sensor further comprises a receiver configured to receive control signals from a transmitter positioned at a location remote from the sensor.

49. (new) A chemical sensor according to claim 41 comprising a plurality of chemical sensing elements arranged in a sensor array.

50. (new) A chemical sensor according to claim 41 wherein the chemical sensing element senses hydrogen.

51. (new) A hydrogen sensor comprising:

a. a hydrogen sensing element for sensing hydrogen, the hydrogen sensing element comprising:

a microcantilever beam; and

a dense reactive layer that specifically absorbs the chemical, wherein the reactive layer is deposited on the microcantilever beam and configured to resist relaxation and to expand as it absorbs hydrogen, thereby causing the microcantilever beam to deflect and allowing the presence of hydrogen to be sensed;

b. a stationary baseplate positioned adjacent to the microcantilever beam such that a condition that exists between the microcantilever beam and the baseplate can change when the reactive layer absorbs hydrogen and causes the microcantilever beam to deflect; and

c. a sensing circuit for measuring a change caused by deflection of the microcantilever beam in response to the reactive layer absorbing hydrogen, wherein a change in capacitance is indicative of an amount of hydrogen in a gas exposed to the sensor.

52. (new) A method for depositing a dense reactive layer onto a substrate for chemical sensing, the method comprising:

using a deposition method for depositing the reactive layer onto the substrate; and

using a densifying method for concurrently densifying the reactive layer during the deposition method.

53. (new) A method for detecting a chemical, comprising exposing a chemical sensor according to claim 41 to a gas suspected or known to contain a chemical to be sensed, and, if the chemical sensor detects the chemical, signaling detection of the chemical.

54. (new) A method for detecting hydrogen, comprising exposing a chemical sensor according to claim 51 to a gas suspected or known to contain hydrogen, and, if the hydrogen sensor detects hydrogen, signaling detection of hydrogen.

CONCLUSION

Applicants respectfully submit that all claims are in condition for allowance, and earnestly solicit an early notice to such affect. Should any issues or questions exist, the Examiner is encouraged to telephone the undersigned at 858.735.7090 so that they may be promptly resolved.

Respectfully submitted,

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